

CLAIMS

1. An engine starting apparatus comprising:

5 a motor for transmitting a torque to an engine of a vehicle to
rotate the engine; and
a motor controlling device for prohibiting rotation of said
motor if the engine runs in reverse rotation.

10 2. The engine starting apparatus according to claim 1, further
comprising a reverse-rotation detecting device for detecting whether
or not the engine runs in the reverse rotation.

15 3. The engine starting apparatus according to claim 2, wherein
the reverse-rotation detecting device detects whether or not the
engine runs in the reverse rotation by detecting a rotational direction
of a crankshaft in an arbitrary cylinder in the engine.

20 4. The engine starting apparatus according to claim 1, further
comprising a reverse-rotation estimating device for estimating
whether or not the engine runs in the reverse rotation.

25 5. The engine starting apparatus according to claim 4, wherein
the reverse-rotation estimating device has a compression-condition
detecting device for detecting a compression condition of a gas in an
arbitrary cylinder in the engine and estimates whether or not the
engine runs in the reverse rotation on the basis of the compression

condition obtained by a detection result by the compression-condition detecting device.

6. The engine starting apparatus according to claim 5, wherein
5 the compression-condition detecting device detects the compression
condition of the gas on the basis of a rotation angle of a crankshaft in
the arbitrary cylinder.

7. The engine starting apparatus according to claim 1, wherein
10 said motor controlling device controls, in accordance with a start
command, said motor to start the engine which is stopped while the
vehicle stops.

8. The engine starting apparatus according to claim 1, further
15 comprising a transmission mechanism for transmitting a torque from
the motor to the engine,

wherein the transmission mechanism comprises: a starter
gear member including a starter gear and a starter gear shaft; a
driven gear member including a driven gear and a driven gear shaft;
20 an intermediate gear member including an intermediate gear and an
intermediate gear shaft; a crank gear member including a crank gear
and a crank gear shaft; and a one-way clutch,

the starter gear member transmits the torque from the starter
motor to the driven gear member, the driven gear member transmits
25 the torque from the starter motor to the intermediate gear member,
the intermediate gear member transmits the torque from the driven

gear member to the crank gear member, the crank gear member transmits the torque from the intermediate gear member to the engine, and the one-way clutch is placed between the driven gear member and the intermediate gear member.

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9. An engine starting method used for an engine starting apparatus comprising: a motor for transmitting a torque to an engine of a vehicle to rotate the engine; and a motor controlling device for prohibiting rotation of said motor if the engine runs in reverse 10 rotation, said motor controlling device controlling, in accordance with a start command, said motor to start the engine which is stopped while the vehicle stops,

 said engine starting method comprising:

 a first process of receiving the start command;

15 a second process of judging whether or not the engine runs in the reverse rotation if the start command is received; and

 a third process of controlling said motor to start the engine if it is judged in said second process that the engine does not run in the reverse rotation.